

Gordon. L. Hager - BIOSKETCH

Education:

1960 -1964 B.S., University of Kansas, Lawrence, Kansas (Honors in Chemistry)
1964 -1968 Department of Genetics, University of Washington, Seattle
1968 -1970 Institut de Biologie Moleculaire, Geneva, Switzerland
1971 Ph.D. in Genetics, University of Washington, Seattle

Brief Chronology of Employment:

1970 - 1971 European Molecular Biology Organization Postdoctoral Fellow, Institut de Biologie de Moleculaire, Universite de Geneve, Geneva, Switzerland
1971 - 1973 National Institute of General Medical Sciences Postdoctoral Fellow, Dept of Biochemistry & Biophysics, UCSF
1973 - 1975 Gianinni Foundation Fellow, Dept of Biochemistry & Biophysics, UCSF
1976 - 1976 Associate Research Biochemist, Dept of Biochemistry & Biophysics, UCSF
1977 - 1979 Expert Consultant, Lab of Tumor Virus Genetics, NCI, NIH, Bethesda, MD
1979 - 1983 Chief, Viral Immunogenetics Section, Lab of Tumor Virus Genetics, NCI, NIH
1983 - 1991 Chief, Hormone Action & Oncogenesis Section, Lab of Exptl Carcinogenesis, NCI, NIH
1991 - 1996 Chief, Hormone Action and Oncogenesis Section, Lab of Molecular Virology, NCI, NIH
1983 - date Adjunct Professor of Genetics, George Washington Univ.
2013 - date External Supervisor, Adelaide Graduate Centre, The University of Adelaide
1996 - date Chief, Laboratory of Receptor Biology and Gene Expression, NCI, NIH

Scientific Recognition and Service:

R.Q. Brewster Outstanding Chemistry Fellow, University of Kansas 1961
Summerfield Scholar, University of Kansas (The Summerfield Scholar Program is the highest academic award at the University of Kansas) 1962
Public Health Service Special Recognition Award, Recognized for Distinguished and Unique Accomplishments in Basic Cancer Research, Dept. of Health and Human Services 1982
Laurentian Hormone Conference Lecture 1983
Pfizer Fellow, Inst de Recherches Cliniques de Montreal, Montreal, Quebec, Canada 1984
NATO International Cooperative Fellowship 1987
Chairman, Gordon Conference on Hormone Action 1990
Karlson Lecture, IMT Symposium, Marburg, Germany 1990
Chair and Meeting Founder, FASEB Summer Conference on Chromatin & Transcription 1991
Fellow, AAAS (Recognized for research on characterization of oncogenes active in human cancer and for research into the mechanisms of mammalian gene regulation) 1993
Chair and Meeting Founder, Keystone Conference on Epigenetic Regulation of Transcription 1995
Co-chair and Meeting Co-founder, Cambridge Symposium on Nuclear Structure-Gene Expression Interrelationships 1996
Chair, Plenary Symposium on Chromatin and Transcription 6th International Congress on Cell Biology 1996
John H. Blaffer Lecture, MD Anderson Cancer Center, University of Texas 1997
Chair, Keystone Conference on Epigenetic Regulation of Transcription 1998
Manuscript, "Direct Visualization..." 1999 Paper of the Year, Mol. Biol. of the Cell 1999
Nat Inst of Health Merit Award (For Outstanding Research Achievements, Mentoring of Scientific Trainees, and Management of the LRBGE) 2001
Chair, Molecular, Cellular and Developmental Biology Faculty, CCR, NCI, NIH 2001-2005
Leaders in the Field Lecture, Johnson Cancer Center, Depts of Biological Chemistry, Microbiology & Immunology, & Howard Hughes Med Inst, UCLA 2004
Chair, Center for Excellence in Chromosome Biology, CCR, NCI, NIH 2006- Present
HHMI-NIH Research Scholars Program Advisor 2006-2009
Merton F. Utter Memorial Lecture, Case Western Reserve University 2006
NIH Director's Award (Novel imaging approaches for the study of gene function in living cells) 2007
Top Science Advance, Center for Cancer Research, NCI, NIH 2009
Keynote Address, European Society of Clinical Investigation 2011

11th William Wallace Scott Research Lecture, Johns Hopkins University	2011	
Keynote Address, PhD Summer School, Univ S. Denmark		2011
Keynote Address, Penn State Summer Symposium in Molecular Biology	2012	
Plenary Address, Endocrine Society Annual Meeting	2012	
Keynote Address, CSH Symposium, Nuclear Receptors and Disease	2012	
Nat Inst of Health Merit Award	2012	
NCI Outstanding Mentor Award	2012	
Manuscript, "The tumour suppressor..." chosen for the prize, Premio De Investigación En Oncología RTICC 2012	2012	
Chair, Keystone Conference on Nuclear Receptors	2014	
Keynote Address, FASEB Summer Conference	2014	

Advisory Panels

Genetics and Biology, National Science Foundation	1983-1987	
NSF Site Visit Panel, Columbia University	1988	
Postdoctoral Fellow Study Section, NIH	1990-1993	
Molecular Biology Study Section, NIH	1991-1995	
Texas Higher Education Coordinating Board, Consultant in Biomedicine	1995	
Chair, MBY Review Panel, Dept of Defense Breast Cancer Research Initiative	1995	
NCI Task Force on Breast Cancer	1997	
External Reviewer: Joint Infrastructure Fund, Medical Research Council (MRC), The Wellcome Trust, & Higher Education Funding Council for England	2000	
CDF-2 Study Section, NIH	2000	
American Institute of Biological Sciences Review of USAMRMC Program	2001	
Howard Hughes Medical Inst Development of the Janelia Farm Research Campus	2004	
Howard Hughes Medical Inst, Advisor, HHMI-NIH Research Scholar Program	2006	
External Advisor, Atlas Consortium, European Union, Development of Laser-ChIP	2010	

Editorships

Associate Editor, Virology	1983-1985	
Editorial Board, Journal of Molc and Cell Biochemistry	1983-1989	
Associate Editor, Molecular Carcinogenesis	1987-1992	
Associate Editor, Cancer Research	1989-1991	
Associate Editor, Receptor	1991-1997	
Editorial Board, Journal of Biological Chemistry	1993-1994	
Associate Editor, Molecular Endocrinology	1992-1993	
Issue Editor, Methods	1999	
Issue Editor, Current Opinion in Cell Biology	2003	
Associate Editor, Epigenetics	2006	

Professional Associations

Adjunct Professor, Graduate Program in Genetics, George Washington University	1983-Present	
Preceptor, Pharmacology Res Assoc Program, Natl Inst General Med Sciences	1986-Present	
American Society of Biochemistry and Molecular Biology	1990-Present	
American Society for Cell Biology	1996-Present	
American Association for the Advancement of Science Elected AAAS Fellow	1981-Present 1997	
American Society for Microbiology	1985-Present	
International Association for Breast Cancer Research	1981-Present	
The Endocrine Society	1985-Present	

Research Interests:

1. Regulation of gene expression in eucaryotic cells
2. Chromatin structure and epigenetic gene regulation
3. Mechanisms of oncogenic transformation

4. Nuclear architecture and dynamics of gene expression

Support:

All research supported by the Intramural Program of the CCR, National Cancer Inst., NIH

Publications (31 from total of 226):

Major Papers

Huang, A.L., Ostrowski, M.C., Berard, D.S. and **Hager, G.L.:** Glucocorticoid regulation of the HaMuSV p21 gene conferred by sequences from mouse mammary tumor virus. *Cell* 27:245-255, 1981.

Cordingley, M.G., Riegel, A.T. and **Hager, G.L.:** Steroid-dependent interaction of transcription factors with the inducible promoter of mouse mammary tumor virus in vivo. *Cell* 48:261-270, 1987.

Richard-Foy, H. and **Hager G.L.:** Sequence specific positioning of nucleosomes over the steroid-inducible MMTV promoter. *EMBO J.* 6:2321-2328, 1987.

Archer, T.K., Lefebvre, P., Wolford, R.G. and **Hager, G.L.:** Transcription Factor Loading on the MMTV Promoter: A Bimodal Mechanism for Promoter Activation. *Science* 255(5051):1573-1576, 1992.

Fragoso, G.S., John, S., Roberts, M.S. and **Hager, G.L.:** Nucleosome positioning on the MMTV LTR results from the frequency-biased occupancy of multiple frames. *Genes Dev.* 9:1933-1947, 1995.

McNally, J.G., Müller, W.G., Walker, D., Wolford, R., and **Hager, G.L.:** The glucocorticoid receptor undergoes rapid exchange with regulatory sites in living cells. *Science* 287:1262-1264, 2000.

Georgel, P.T., Fletcher, T.M., **Hager, G.L.**, and Hansen, J.C.: Formation of higher-order secondary and tertiary chromatin structures by genomic mouse mammary tumor virus promoters. *Genes Dev.* 17:1617-1629, 2003.

Nagaich, A.K., Walker, D.A., Wolford, R.G., and **Hager, G.L.:** Rapid periodic binding and displacement of the glucocorticoid receptor during chromatin remodeling. *Molecular Cell* 14:163-174, 2004.

Elbi, C., Walker, D.A., Lewis, M., Romero, G., Sullivan, W.P., Toft, D.O., **Hager, G.L.**, and DeFranco, D.B.: A novel in situ assay for the identification and characterization of soluble nuclear mobility factors. *Science STKE* 238:PL10, 2004.

Nagaich, A.K., and **Hager, G.L.:** UV laser cross-linking: A real-time assay to study dynamic protein/DNA interactions during chromatin remodeling. *Science STKE* 256: PL13, 2004.

Qiu, Y., Zhao, Y., Becker, M., John, S., Parekh, B.S., Huang, S., Hendarwanto, A., Martinez, E.D., Chen, Y., Lu, H., Adkins, N.L., Wiench, M., Georgel, P.T., Schiltz, R.L., and **Hager, G.L.:** HDAC1 acetylation is linked to progressive modulation of steroid receptor induced gene transcription. *Molecular Cell* 22(5):669-679, 2006.

Stavreva, D.A., Wiench, M., John, S., Conway-Campbell, B.L., McKenna, M.A., Pooley, J.R., Johnson, T.A., Voss, T.C., Lightman, S.L., John, S., and **Hager, G.L.:** Gene pulsing by the glucocorticoid receptor dynamics couples with ultradian secretion to appropriately regulate gene targets. *Nature Cell Biol.* (11:1093-1102, 2009.

John, S., Thurman, R.E., Sabo, P.J., Sung, M.H., Biddie, S.C., Johnson, T.A., **Hager, G.L.**, and Stamatoyannopoulos, J.A.: Chromatin accessibility dictates de novo regulatory factor binding. *Nat.Gen.* 43, 264-8, 2011.

Voss, T.C., Schiltz, R.L., Sung, M.H., Yen, P.M., Stamatoyannopoulos, J.A., Biddie, S.C., Johnson, T.A., Miranda, T.B., John, S., and **Hager, G.L.:** Dynamic exchange at regulatory elements during chromatin remodeling underlies assisted loading mechanism. *Cell* 146:544-554, 2011.

Recent Papers

Klokk, T.I., Kurys, P., Elbi, C., Nagaich, A.K., Hendarwanto, A., Slagsvold, T., Chang, C.-Y., **Hager, G.L.**, and Saatcioglu, F.: Ligand-specific dynamics of the androgen receptor at its response element in living cells. *Mol.Cell.Biol.* 27:(5)

1823-1843, 2007.

Meijsing, S.H., Elbi, C., Luecke, H.F., **Hager, G.L.**, and Yamamoto, K.R.: The ligand binding domain controls glucocorticoid receptor dynamics independent of ligand release. *Mol.Cell.Biol.* 27:2442-2451, 2007.

Dundr, M., Ospina, J.K., Sung, M.H., John, S., Upender, M., Ried, T., **Hager, G.L.**, and Matera, A.G.: Actin-dependent intranuclear repositioning of an active gene locus in vivo. *J. Cell Biol.* 179:1095-1103, 2007.

John, S., Sabo, P.J., Johnson, T.A., Sung, M.H., Davis, S., Meltzer, P., Stamatoyannopoulos, J.A., and **Hager G.L.**: Interaction of the glucocorticoid receptor with the chromatin landscape. *Molecular Cell* 29:611, 2008.

Johnson, T.A., Elbi, C., Parekh, B.S., **Hager G.L.**, and John, S.: Chromatin remodeling complexes interact dynamically with a glucocorticoid receptor- regulated promoter. *Mol.Biol.Cell.* 19:3308-3322, 2008.

Voss, T.C., and Hager G.L.: Visualizing chromatin dynamics in intact cells. *Biochim. Biophys. Acta Mol. Cell Res.* 1783:2044-2051, 2008.

Sung, M.H., Bagain, L., Chen, Z., Karpova, T.S., Yang, X., Silvin, C., Voss, T.C., McNally, J.G., Van Waes, C., and **Hager, G.L.**: Dynamic effect of NFkB and bortezomib on gene expression in tumor cells. *Mol Pharmacol.* 74:1215-1222, 2008.

George, A., Schiltz, R.L. and **Hager G.L.**: Dynamic access of the glucocorticoid receptor to response elements in chromatin. *Int. J. Biochem. Cell Biol.* 41:214-224, 2009.

Voss, T.C. and **Hager G.L.**: Stochastic action of the glucocorticoid receptor. *J. Cell Science.* 122:345, 2009.

John, S., Johnson, T.A., Sung, M.H., Koch-Paiz, C.A., Davis, S.R., Walker, R., Meltzer, P., and **Hager G.L.**: Kinetic complexity of the global response to glucocorticoid receptor action. *Endocrinology* 150:1766, 2009.

Hakim, O., John, S., Ling, J.Q., Sabo, P.J., Stamatoyannopoulos, G., Hoffman, A.R., and **Hager G.L.**: Glucocorticoid receptor activation of the Ciz1-Lcn1 locus by long range interactions. *J. Biol. Chem.* 284:6048-6052, 2009.

Hager, G.L., McNally, J.G., and Misteli, T.: Transcription dynamics. *Molecular Cell* 35:741-753, 2009.

Siersbaek, R., Nielsen, R., John, S., Sung, M.H., Baek, S., Loft, A., **Hager, G.L.**, and Mandrup, S.: Adipogenic development is associated with extensive early remodeling of the chromatin landscape and establishment of transcription factor 'hotspots'. *EMBO J* 30(8), 1459-72, 2011.

Hakim, O., Sung, M.H., Voss, T.C., John, S., Splinter, E., Sabo, P.J., Thurman, R.E., Stamatoyannopoulos, J.A., de Laat, W., and **Hager, G.L.**: Diverse gene reprogramming events occur in the same spatial clusters of distal regulatory elements. *Genome Research* 21, 697-706, 2011.

Wiench, M., John, S., Baek, S., Sung, M.H., Escobar, T., Johnson, T.A., Simmons, C.A., Pearce, K.H., Biddie, S.C., Sabo, P.J., Thurman, R.E., Stamatoyannopoulos, J.A., and **Hager, G.L.**: DNA methylation status predicts cell-type-specific enhancer activity. *EMBO J.* 30, 3028-3039, 2011.

Biddie, S.C., John, S., Sabo, P.J., Thurman, R.E., Johnson, T.A., Schiltz, R.L., Miranda, T.B., Sung, M.H., Trump, S., Lightman, S.L., Vinson, C., Stamatoyannopoulos, J.A., and **Hager, G.L.**: Transcription factor AP1 potentiates chromatin accessibility and glucocorticoid receptor binding. *Molecular Cell* 43:145-155, 2011.

Grontved, L., John, S., Baek, S., Liu, Y., Buckley, J.R., Vinson, C., Aguilera, G., and **Hager, G.L.**: C/EBP maintains chromatin accessibility in liver and facilitates GR recruitment to response elements. *EMBO J* 32, 1568-1583, 2013.

Nakahashi, H., Kwon, K.R., Resch, W., Vian, L., Dose, M., Stavreva, D., Hakim, O., Pruett, N., Nelson, S., Yamane, A., Qian, J., Dubois, W., Welsh, S., Phair, R.D., Pugh, B.F., Lobanenko, V., **Hager, G.L.**, and Casellas, R.: A Genome-wide Map of CTCF Multivalency Redefines the CTCF Code. *Cell Reports* 3, 1678-1689, 2013.

Miranda, T.B., Voss, T.C., and Hager, G.L.: High-throughput fluorescence-based screen to identify factors involved in nuclear receptor recruitment to response elements. *Methods Mol. Biol.* 1042, 3-12, 2013.

Grontved, L., John, S., Baek, S., Liu, Y., Buckley, J.R., Vinson, C., Aguilera, G., and Hager, G.L.: C/EBP maintains chromatin accessibility in liver and facilitates GR recruitment to response elements. *EMBO J* 32, 1568-1583, 2013.

Miranda, T.B., Morris, S.A., and Hager, G.L.: Genomic interactions in the dynamic regulation of transcription by the glucocorticoid receptor. *Mol. Cell Endocrinol.* 380, 16-24, 2013.

Miranda, T.B., Voss, T.C., Sung, M.H., Baek, S., John, S., Hawkins, M., Grontved, L., Schiltz, R.L., and Hager, G.L.: Reprogramming of the chromatin landscape: ER and GR interplay at the genome level. *Cancer Research* 73, 5130-5139, 2013.

Nakahashi, H., Kwon, K.R., Resch, W., Vian, L., Dose, M., Stavreva, D., Hakim, O., Pruett, N., Nelson, S., Yamane, A., Qian, J., Dubois, W., Welsh, S., Phair, R.D., Pugh, B.F., Lobanenko, V., Hager, G.L., and Casellas, R.: A Genome-wide Map of CTCF Multivalency Redefines the CTCF Code. *Cell Rep.* 3, 1678-1689, 2013.

He, X., Chatterjee, R., John, S., Bravo, H., Sathyanarayana, B.K., Biddie, S.C., FitzGerald, P.C., Stamatoyannopoulos, J.A., Hager, G.L., and Vinson, C.: Contribution of nucleosome binding preferences and co-occurring DNA sequences to transcription factor binding. *BMC Genomics* 14, 428, 2013.

Mousavi, K., Zare, H., Dell'Orso, S., Grontved, L., Gutierrez-Cruz, G., Derfoul, A., Gordon L. Hager, G.L. and Sartorelli, V.: eRNAs Promote Transcription by Enhancing Chromatin Accessibility at Defined Genomic Loci. *Molecular Cell* 51, 606-617, 2013.

Dull, A.B., George, A.A., Martinez, E.D., Voss, T.C., Goncharova, E., Hager, G.L., and McMahon, J.A.: Identification of compounds by high content screening that induce cytoplasmic to nuclear localization of a fluorescent estrogen receptor alpha chimera and exhibit agonist or antagonist activity in vitro. *J. Biomol. Screen.* (in press) 2013.

Aguilar-Arnal, L., Hakim, O., Patel, V.R., Baldi, P., Hager, G.L., and Sassone-Corsi, P.: Cycles in spatial and temporal chromosomal organization driven by the circadian clock. *Nature Struct. Mol Biol.* 20, 1206-1213, 2013.

Lalmansingh, A.S., Arora, K., Demarco, R.A., Hager, G.L., and Nagaich, A.K.: High-throughput RNA FISH analysis by imaging flow cytometry reveals that pioneer factor Foxa1 reduces transcriptional stochasticity. *PLoS One* 8, e76043, 2013.

Morris, S., Baek, S., Sung, M.H., John, S., Wiench, M., Schiltz, R.L., and Hager, G.L.: Multiple overlapping mammalian chromatin remodeling systems collaborate genome-wide at dynamic chromatin transitions. *Nature Struct. Mol Biol.* 21, 73-81, 2014.

Presman, D.M., Ogara, M.F., Stortz, M., Alvarez, L.D., Johnson, T.A., Grontved, L., Burton, G., Levi, V., Hager, G.L., and Pecci, A.: A truly monomeric Glucocorticoid Receptor mutant: role of multiple domains on in vivo dimerization. *PLoS Biol.* (in press) 2014.

Miranda, T.B., Hager, G.L., and Voss, T.C.: Establishing automated image analysis procedures for measurement of steady-state transcription factor interactions with specific target chromatin in single cells. *Methods Mol. Biol.* (in press) 2014.

Voss, T.C. and Hager, G.L.: Dynamic interaction of transcription factors and chromatin. *Nature Reviews Genetics* (in press) 2014.

Sung, M.H., Li, N., Lao, Q., Gottschalk, R.A., Hager, G.L., and Fraser, I.D.: Switching of the Relative Dominance Between Feedback Mechanisms in Lipopolysaccharide-Induced NF-kappaB Signaling. *Sci Signal.* 7, ra6, 2014.